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[10] Roth and Auwers, *Liebig's Ann. Chem., Leipzig*, **407**, 1914, (154, 158).

[11] For example, 2–4 Dimethyl hexane, boiling point 110°, L. Clarke, *J. Amer. Chem. Soc., Easton, Pa.*, **30**, 1908, (1148). Octanes have higher specific heats of combustion than toluene. (Richards and Jesse, *Ibid.*, **32**, 1910, (292).

THE MASS OF THE ELECTRIC CARRIER IN COPPER, SILVER AND ALUMINIUM

By Richard C. Tolman and T. Dale Stewart

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In a previous article [*Physic. Rev.*, **8**, 97 (1916), these PROCEEDINGS **2**, 189 (1916)] we have described some experiments in which a coil of copper wire was rotated about its axis at a high speed and then suddenly brought to rest, the ends of the coil being connected with a sensitive ballistic galvanometer which permitted a measurement of the pulse of current which was produced at the instant of stopping by the tendency of the electrons to continue in motion.

We have continued these experiments making use of three new windings of copper wire, and using two different windings each of silver and aluminium wire. These further experiments were made, not only because it seems desirable to subject so new a phenomenon to a more rigid test, but because it is also desirable to see if the mass of the carrier of electricity is the same in all different metals and how much it differs, if at all, from the mass of the electron in free space.

We now have a record of the results of 624 individual runs made on a number of different coils, using three kinds of wire, two different sizes, and two different kinds of insulating binder to hold the coils in place. The runs were made with various total resistances in the circuit, with various lengths of wire, and at various velocities, rotating sometimes in one direction and sometimes in the other. Not only was the pulse of electricity every time in the direction which would be predicted on the basis of a mobile *negative* electron as the carrier of electricity,

but the experiments have led to concordant results for the mass of this carrier. In free space the mass of the electron may be taken as 1/1845 times that of the hydrogen atom, while we have found for the carrier in copper 1/1660, in aluminium 1/1590, and in silver 1/1540. We hope to construct a new apparatus which will increase the accuracy of measurement enough so that we can make certain whether the mass of the carrier is really larger in metals than in free space.

A more complete account of these experiments has been accepted by the *Physical Review* for publication.

THE SILVER VOLTAMETER AS AN INTERNATIONAL STANDARD FOR THE MEASUREMENT OF ELECTRIC CURRENT

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The International Electrical Conference which met in London in 1908 adopted the ampere as the second fundamental electrical unit, the ohm being the first, and defined the international ampere in terms of the electrolytic deposit of silver in the silver voltameter. At the time of this conference it was the opinion of the delegates from this country that the volt should have been chosen in place of the ampere, because the standard cell was more reproducible than the silver voltameter and was the means then as now actually employed (in conjunction with the ohm) for measuring the ampere by the drop in potential method. The decision of the conference was, however, accepted as final, and researches were undertaken in several different countries, and particularly in this country, with the aim of making the voltameter worthy to bear the responsibility imposed upon it by the London Conference. The purpose of this paper is to give briefly the most important results that have been obtained and to show the remarkable agreement of the measurements recently made in the national laboratories of several different countries of the electromotive force of a Weston normal cell, in terms of the international volt as officially defined. This agreement is due to the fact that great advances have been made in our knowledge of the silver voltameter in recent years; and although no adequate specifications have been formally adopted, the methods followed by recent investigators have agreed in essential particulars, although differing in details.

No concrete standard for the ampere, corresponding to the column